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A COMPARATIVE STUDY OF THE RESULTS OBTAINED IN INSTRUCTION IN THE "SINGLE TEACHER" RURAL SCHOOLS AND THE GRADED TOWN SCHOOLS¹

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In the rural sections of this country there has recently been considerable agitation for the consolidation of a number of the smaller school districts into one large district. With one commodious schoolhouse, several teachers, and a large number of children transported at public expense to a central school, it has been possible to adopt the grade system. This method of organization is considered an advantage by some, but by others it is held to be a detriment to successful learning. This study is an effort to gather data which will measure the contribution of grade organization to elementary education. No amount of opinion can solve the problem, and even this investigation can hope only to point out a method by which material may be gathered and presented. Aside from its contribution to the methods and results of "experimental education," this study indicates some of the weaknesses of our school organization and thus suggests a departure from the conventional form of organization for our consolidated rural schools.

The method used is a comparison of the "single teacher" rural schools with a number of graded town schools. This method was feasible because in the two systems there was only one factor that was not common to both, and that was the

¹The writer is indebted to County Superintendents D. E. Brainard, F. L. Hoffman, G. E. Farrell, A. M. Deyoe, C. H. Miller, Estelle Coon, A. L. Heminger, and H. McVicker; to City Superintendents C. R. Golly, A. C. Grubb, W. R. Merriss, F. P. Reed, F. W. Malke, H. S. Dewelle, E. M. Carson, C. M. Parker, Margaret Buchanan, Thomas Smiley, H. E. Dow, W. R. Sandy, Alfred Williams, A. J. Quigg, and H. E. Blackmar; and to Professors F. E. Bolton, C. E. Seashore, and C. H. Judd.

grade system. Examinations were given to eighth-grade pupils in arithmetic, geography, grammar, history, and spelling. The same questions were submitted, at the same time, with the same instructions, to pupils of the same age, who had studied the same textbooks. These pupils came from the same class of people, and had teachers of about equal preparation.

In selecting the questions for the tests in each subject the following principles were observed. The questions were to cover all of the subject-matter expected below high school. No catch questions should be admitted. The questions should emphasize both the mechanical and reasoning elements and should be so classified. No questions should be selected that would emphasize one method of instruction more than another. Previous eighth-grade examination lists in both city and county examinations, questions mentioned in textbooks, and the studies of Drs. Stone and Cornman were used. The arithmetic questions were selected directly from the set prepared by Dr. Stone, "Some Arithmetical Abilities of 6A Children." The questions in spelling were adopted from Dr. Cornman's study, "Spelling in the Elementary Schools, an Experimental and Statistical Investigation." Questions in other subjects were prepared as follows. After about forty questions had been selected they were submitted to the pupils of the eighth grade of the Iowa City schools and to the pupils of the rural-school District No. 1, West Lucas Township, Johnson County, Iowa. The answer papers were all gone over carefully and the value of the answers was estimated. If the answer was perfect, it was marked 1. An answer that was entirely wrong was marked 0, and those that were considered partly right were given a fractional grade. The results were all tabulated and each question ranked in the order of the number of times that it had been answered correctly.² The best twenty questions were then adopted for the tests.

METHOD OF GATHERING DATA

Ten county superintendents and fourteen town superintendents signified their willingness to co-operate with us. To these

² Thorndike, *Educational Psychology*, 169.

we sent the lists of questions accompanied by the following directions:

It seems that the best way to choose the schools is for you to pick out enough schools so that the tests can be given to from 20 to 30 eighth-grade pupils in your county. Your acquaintance with your schools will enable you to choose those in average communities, with teachers of average ability. The schools near towns, from which the brightest pupils go to the town schools before the age of fifteen, should not be chosen. We are sending all the questions to you in the hope that you will send them to teachers who will take an interest in the work, and who will be honest in living up to the "directions." If you send them out next week the tests could be given beginning Monday, February 14, 1910.

The only directions sent to the town superintendents were that they require the teachers to give the tests, and that they live up to all directions.

The following directions were sent to each teacher:

Have all the pupils in the eighth grade take the tests. By eighth grade we mean those who will finish the common school branches this year and be ready for the high school next year.

Do not give any explanations, suggestions, corrections, intimations, or any other help to any pupils, and do not have them make any preparations for the tests. (This is important. To make the work of any scientific value you must consider yourself responsible for the fairness of the examinations. Be on your guard against cheating in any form by the pupils.) The object of the examination is to compare school systems, not to test individual schools, therefore the conditions should be the same.

If possible give the tests in the forenoon immediately after the school has been called together. A good order might be to give arithmetic Monday, history Tuesday, geography Wednesday, grammar Thursday, and spelling Friday. Dictate the directions to the pupils for spelling.

Record on each paper the time required for the completion of the examination. Tell the pupils that you are going to do this before the tests begin. Please see to it that the questions to be answered by the pupil are answered correctly. Do not allow them to ask questions about anything.

QUESTIONNAIRE TO THE TEACHER

How many classes have you daily?

How many pupils under your charge?

How many grades?

What textbooks do you use in each subject?

About what is the daily attendance?

How long have you held your present position?

The following questionnaire and directions were given to each pupil:

Give the year,..... month,..... and day..... of your birth. Boy or girl.....? Name or number of your school..... Twp.....? Co.....? Date.....?

What work have you done in this subject, giving books studied, and time spent upon it?

Do not copy the questions. Write on both sides of the paper. Do not ask any questions. Do not waste time, because you should finish these tests as soon as possible without hurrying. Your teacher records the time required.

METHOD OF HANDLING DATA

Reports were received from 213 town children and 176 country children. The papers in each subject were arranged and numbered. The towns and counties were each given a Roman numeral, and the country schools a letter, and the pupils were assigned Arabic numerals. (Thus in referring to No. 9, New Albany Twp., Story Co., as an illustration, we call the county, XIV; school, *a*; pupil, No. 3, 2, 1.) This method of numbering the papers enables one to go to any paper at any time and verify the results in the tables. It also makes it possible to withhold the name of the school from the public, and at the same time give out the results.

In marking the papers all answers were marked 0, when wrong or only partially correct; and 1, when correct. All papers in one subject were marked before another subject was begun. If the papers from the rural schools were marked first in arithmetic, the papers from the graded schools were marked first in the next subject. This was done to shift the effect of any unconscious change in the method of marking. In all cases where there was doubt as to what the ruling should be in any situation, a written memorandum was kept of the ruling, as a guide for similar cases. All of the papers except a few in spelling were marked by the writer; during the marking of these spelling papers he was present to supervise.

ARITHMETIC

Dr. Stone's lists which were prepared for 6A children contained twelve questions each. Since we were to deal only with eighth-grade pupils we felt that it was not necessary to use so many and therefore selected the more difficult questions as better for our purpose. Only the last seven problems in "fundamentals" and the last eight in "reasoning" were used. Dr. Stone listed in his group of "fundamentals" the questions that were designed to test the operations in addition, multiplication, division, and subtraction.

The questions submitted in the fundamentals follow:

1. Add 4695, 872, 6786, 567, 858, 9447, 7499.
2. Multiply 976 by 87.
3. Divide 278254 by 678.
4. Multiply 5489 by 9876.
5. Divide 5099941 by 740.
6. Multiply 876 by 749.
7. Divide 62693256 by 859.

Papers were received from 60 "single teacher" and 14 graded schools. The results are tabulated in Tables 1, 2, 3, and 4. In calculating the results in the "fundamental" operations each problem was divided into a number of parts. The following method of division was used. Question 1= $4a$; 2= $3a$, $2m$; 3= $4m$, $4d$, $2s$; 4= $6a$, $4m$; 5= $4m$, $4d$, $4s$; 6= $4a$, $3m$; 7= $5m$, $5d$, $4s$. In this table a means addition; m , multiplication; d , division; and s , subtraction; the numbers before the sign of equality designate the number of the problem. This table was developed as a fairer means of interpreting the results than the use of answers.³ Dr. Stone⁴ says that there was little difference in the mistakes made when adding a short or a long column of figures. This being true it seems fair to arrange the problems on the above basis. Another method was considered but rejected because of its greater length. In it each separate opera-

³ Curtis, *Elementary School Teacher*, October, 1910.

⁴ Stone, "Some Arithmetical Abilities of 6A Children."

tion constitutes a problem. The seventh problem is used to illustrate the method used.

$$\begin{array}{r}
 859) 62693256 \text{ (72984} \\
 \underline{6013} \\
 2563 \\
 \underline{1718} \\
 8452 \\
 \underline{7731} \\
 7215 \\
 \underline{6872} \\
 3436 \\
 \underline{3436}
 \end{array}$$

In the first place there are five divisions. If there were two mistakes in the quotient, 2 was subtracted from the number 5, leaving 3 the mark for division. In solving this problem the divisor was multiplied by each number in the quotient, making five separate operations. Each operation was considered an operation in multiplication, and if no mistakes were made the answer was given the mark 5*m*. There were only four operations of subtraction if no mistakes were made, because there should be no remainder. If there was no mistake in the solution of the seventh problem, the mark would be 5*m*, 5*d*, 4*s*. The results of all of the operations are arranged in the tables and the comparisons made from the tables. The Roman numerals in the horizontal column at the top of the tables indicate the school if it is graded, and the county if it is of the "one teacher" rural system. There are in this column fourteen graded schools and eight counties. The fundamental operations are arranged in order. The vertical column at the left of the page indicates the problem in which the operation is found. The same problem may occur under three different heads, multiplication, division, and subtraction. The horizontal columns contain the results for each school in each operation. The vertical column marked T contains the totals for the horizontal columns. The column marked P indicates what the total should be if there were no

TABLE I. ARITHMETIC
BOYS, GRADED SCHOOLS, FUNDAMENTALS

GRADES AND NUMBER OF PUPILS															P	PERCENTAGE
I 7	II 16	III 10	IV 5	V 0	VI 11	VII 6	VIII 7	IX 5	X 7	XI 10	XII 8	XIII 14	XIV 8	T 114		
ADDITION																
28	57	40	20	39	22	28	20	28	40	28	51	20	..	430	456	
21	49	29	15	33	18	21	15	20	30	24	42	24	..	341	342	
42	91	58	30	66	34	42	30	42	60	44	83	48	..	670	684	
28	64	40	19	44	23	28	20	27	40	32	54	31	..	450	456	
														1,891	1,938	98
MULTIPLICATION																
13	22	30	9	15	10	14	10	14	20	15	28	15	..	221	226	
28	64	34	20	38	24	27	20	27	39	30	56	32	..	439	456	
28	55	28	12	43	18	17	16	27	40	31	55	29	..	390	456	
26	63	46	20	38	22	24	18	28	40	32	56	25	..	438	456	
20	46	29	13	31	17	20	15	21	27	37	42	22	..	340	342	
32	68	48	25	48	24	32	25	35	47	53	70	39	..	546	570	
														2,383	2,506	95
DIVISION																
27	63	36	20	33	24	26	20	27	39	27	55	30	..	427	456	
27	57	32	19	31	22	24	17	24	32	32	52	24	..	393	456	
32	60	40	23	45	23	32	24	33	49	39	68	30	..	498	570	
														1,318	1,482	89
SUBTRACTION																
13	32	20	10	19	12	12	10	14	18	14	28	16	..	218	228	
28	63	39	19	38	23	27	20	27	28	32	52	28	..	425	456	
26	59	38	20	37	19	26	19	28	40	32	55	30	..	432	456	
														1,075	1,140	94

TABLE II. ARITHMETIC
GIRLS, GRADED SCHOOLS, FUNDAMENTALS

GRADES AND NUMBER OF PUPILS																P	PERCENTAGE
I 7	II 5	III 15	IV 6	V 8	VI 6	VII 2	VIII 5	IX 0	X 7	XI 7	XII 14	XIII 12	XIV 3	T 97			
ADDITION																	
26	20	48	22	32	23	4	24	..	28	27	56	45	11	366	378	95	
21	15	44	18	23	18	6	15	..	20	20	42	36	9	287	291		
41	29	81	36	47	36	12	30	..	41	42	84	72	18	569	582		
27	20	55	24	31	24	8	20	..	27	28	56	48	12	368	378		
														1,590	1,629		
MULTIPLICATION																	
13	10	26	12	13	12	4	9	..	14	14	28	24	6	185	189	94	
26	20	52	24	32	24	8	20	..	28	27	56	47	11	375	378		
27	20	41	18	23	21	6	15	..	27	27	54	48	9	336	378		
28	20	50	24	32	24	8	20	..	28	28	55	48	12	377	378		
21	15	40	18	24	17	6	14	..	21	21	28	35	8	268	291		
34	25	69	30	38	25	10	24	..	35	33	55	55	15	448	485		
														1,989	2,099		
DIVISION																	
21	20	49	24	32	24	8	20	..	28	24	56	47	10	363	378	91	
26	18	50	24	32	24	8	20	..	28	25	56	46	12	369	378		
28	25	60	30	35	25	10	20	..	33	28	63	51	14	422	485		
														1,154	1,241		
SUBTRACTION																	
14	10	25	12	16	12	4	10	..	14	14	28	24	6	189	189	95	
27	19	53	24	32	24	8	20	..	28	18	55	47	12	367	378		
26	20	51	24	32	20	8	20	..	28	28	54	42	12	365	378		
														921	945		

TABLE III. ARITHMETIC
BOYS, "ONE TEACHER" SCHOOLS, FUNDAMENTALS

GRADES AND NUMBER OF PUPILS									P	PERCENTAGE
I 12	II 5	III 9	IV 2	V 6	VI 10	VII 9	VIII 4	T 57		
ADDITION										
46	20	35	8	24	36	35	16	220	228	99
36	15	27	6	18	30	27	12	171	171	
71	30	54	12	36	60	53	24	340	342	
48	20	36	8	24	40	35	16	227	228	
								958	969	
MULTIPLICATION										
21	10	18	4	13	48	16	8	138	114	93
48	20	36	8	24	33	36	16	221	228	
42	19	36	8	24	36	34	16	215	228	
44	20	34	8	24	33	32	16	151	228	
34	15	25	6	18	26	26	12	162	171	
59	25	42	10	29	48	45	15	273	285	
								1,160	1,254	
DIVISION										
48	20	36	8	24	39	36	16	227	228	92
44	20	31	8	26	24	29	16	198	228	
51	13	42	9	29	43	50	20	257	285	
								682	741	
SUBTRACTION										
23	15	18	4	12	20	18	8	118	114	99
47	20	39	8	24	34	36	16	224	228	
47	19	35	8	24	39	35	16	223	228	
								565	570	

TABLE IV. ARITHMETIC
GIRLS, "ONE TEACHER" SCHOOLS, FUNDAMENTALS

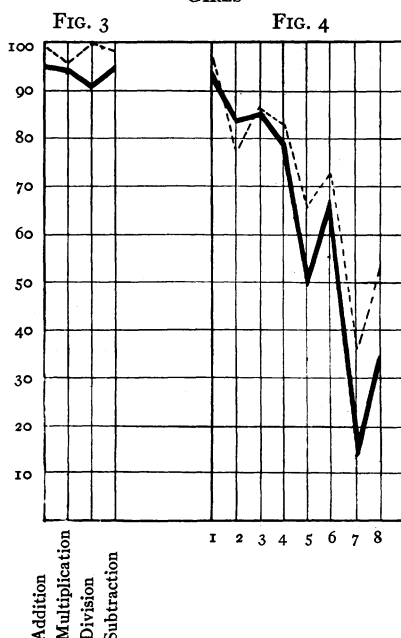
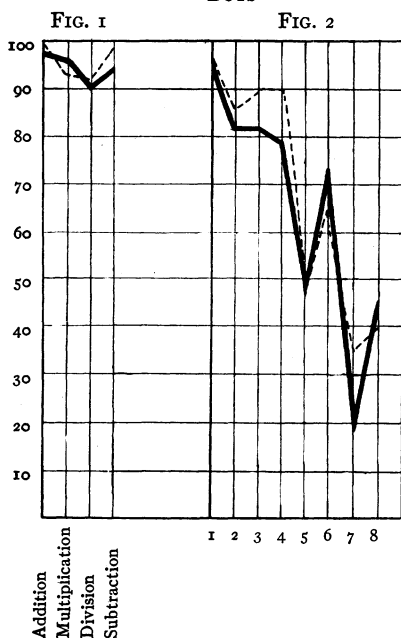
GRADES AND NUMBER OF PUPILS									P	PERCENTAGE
I 13	II 15	III 20	IV 11	V 15	VI 5	VII 18	VIII 14	T 111		
ADDITION										
50	59	76	44	60	20	68	52	431	444	98
39	45	60	33	45	15	54	42	333	333	
78	90	118	66	90	30	103	84	659	666	
52	59	80	43	60	20	72	56	442	444	
								1,865	1,887	
MULTIPLICATION										
25	30	40	20	29	10	35	28	217	222	97
51	60	79	41	59	18	71	56	435	444	
48	59	78	44	60	15	69	55	426	444	
51	60	80	40	56	19	63	54	423	444	
39	45	60	31	45	15	54	40	329	333	
65	74	99	51	69	23	76	70	527	555	
								2,357	2,442	
DIVISION										
48	60	78	41	60	18	69	56	430	444	99
41	60	78	41	50	13	60	49	492	444	
56	75	98	49	67	23	75	70	513	555	
								1,435	1,443	
SUBTRACTION										
26	30	40	22	30	10	36	28	222	222	98
52	60	75	44	60	20	65	55	431	444	
51	60	79	44	60	20	60	56	430	444	
								1,083	1,110	

mistakes. And the column marked Percentage indicates the percentage which is the result obtained by dividing the quantity in Column T, by the quantity in Column P. There are two tables for each subject, one containing the results from the boys' papers, and the other from the girls' papers.

ARITHMETIC

Boys

Girls



In the curves based upon these tables the broken lines indicate the results from the "one teacher" and the full lines the results from the graded schools. Figures 1 and 2 are comparisons of the boys for fundamentals and reasoning respectively. Figures 3 and 4 show results for the girls.

REASONING PROBLEMS

1. The uniforms for a baseball nine cost \$2.50 each. The shoes cost \$2.00 a pair. What was the total cost of the uniforms and shoes for the nine?

2. In the schools of a certain city there are 2,200 pupils; one-half are in the primary grade, one-eighth in the high school, and the rest in the night school. How many pupils are there in the night school?

TABLE VI. ARITHMETIC
GIRLS, GRADED SCHOOLS, REASONING PROBLEMS

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	T	P	Percentage
1.....	7	4	15	6	7	6	2	5	...	7	6	14	10	3	92	97	95
2.....	6	5	13	5	4	4	2	5	...	6	7	11	10	3	81	97	83
3.....	5	5	10	6	8	6	2	4	...	7	5	13	10	3	86	97	76
4.....	4	4	13	6	6	3	2	5	...	6	5	13	8	2	77	97	88
5.....	1	5	2	5	3	1	2	3	...	4	2	12	5	2	47	97	48
6.....	3	5	7	5	4	3	1	4	...	4	5	13	8	3	62	97	67
7.....	1	0	0	0	1	0	1	1	...	0	0	6	1	2	13	97	13
8.....	1	4	2		4	1	1	0	...	3	2	5	5	2	33	97	34
Number of pupils	7	5	15	6	7	6	2	5	0	7	7	14	12	3	97	97	

"ONE TEACHER" SCHOOLS, REASONING PROBLEMS

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	T	P	Percentage
1.....	12	15	19	11	15	5	18	14	...	...	...	...	...	...	109	III	99
2.....	12	10	13	10	13	2	14	11	...	...	...	...	...	...	85	III	77
3.....	11	15	20	7	14	5	11	13	...	...	...	...	...	...	6	III	86
4.....	8	14	18	9	13	3	14	14	...	...	...	...	...	...	93	III	84
5.....	6	13	16	8	11	1	5	13	...	...	...	...	...	...	73	III	65
6.....	6	12	19	9	14	2	11	13	...	...	...	...	...	...	86	III	72
7.....	3	11	5	4	7	0	6	4	...	...	...	...	...	...	40	III	36
8.....	4	14	9	8	6	1	5	12	...	...	...	...	...	...	59	III	53
Number of pupils	13	15	20	11	15	5	18	14	...	...	...	...	...	...		III	

columns contain the number of correct answers for each school or county. The vertical columns marked T, Percentage, and P contain the sum of correct answers, the percentage of correct answers, and the sum of the answers had there been no errors. The percentage is obtained by dividing the sum of the correct answers by the sum of the answers if no mistakes were made.

GEOGRAPHY QUESTIONS

1. Name and locate five important cities in Iowa.
2. In what state is each of the following cities: St. Louis, New Orleans, Cleveland, Davenport, Omaha, Minneapolis, Pittsburgh, Boston, Seattle, San Francisco?
3. What parts of the earth have four seasons?
4. Locate the Isthmus of Panama.
5. Name and locate three mountain ranges in the United States.
6. What is the climate of Porto Rico?
7. Into what zones is the earth's surface divided?
8. What are five important minerals of the United States?

9. Name three commercial advantages of Chicago, and explain how they have affected the growth of that city.
10. The Mississippi River forms the eastern boundary of what states?
11. Locate Oxford, Berlin, Rome, St. Petersburg, Copenhagen, the Hague, Geneva, Venice, Athens, Manila.
12. How did the United States gain possession of the Philippines?
13. Name five important pork-packing cities.
14. Name three reasons why the eastern part of our country is so thickly settled.
15. In what states and territories are the gold mines of the United States?
16. What country of South America is likely to become an important rival of the United States in cattle and wheat raising? Why?
17. To what country do we export most of our cattle products? Why?
18. In what three parts of Europe are the principal mountain ranges?
19. How do you account for the difference in climate between Oregon and New England?
20. What are the three things that mainly affect climate?
21. What are the three movements of the waters of the ocean?
22. Name the capitals of England, France, Brazil, Japan, Chili.

GEOGRAPHY

According to our general plan we have divided these questions into two groups, "mechanical" and "reasoning." Questions 1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 15, 18, 20, 21, and 22 are called "mechanical," and 6, 9, 13, 14, 16, 17, and 19 are called "reasoning" questions. This classification is of course only a rough attempt at analyzing the mental processes used in answering the questions, but in general seems justifiable. Under "mechanical" are classed those questions that seem to require little more than mere memory. There are however under this classification questions that range from mere visual imagery to problems of reasoning. Question 10 is an example of the first, and Question 11 of the second sort. In either case the process used in answering the question may be only memory, but again it may be that the child recalls the location of the place by means of his power to reason.

In marking the papers no more definite location was required than the assignment of cities to their proper country. In this subject the same method of tabulation was used as has been

previously described as being used in arithmetic, but to save space only the percentage results are here presented.

TABLE VII. GEOGRAPHY
PERCENTAGES

"ONE TEACHER" SCHOOLS		GRADED SCHOOLS	
57 Boys	115 Girls	106 Boys	97 Girls
89	81	85	82
91	92	95	77
51	48	50	49
99	46	88	84
76	71	69	73
91	88	76	66
92	86	73	78
100	97	99	89
51	59	51	41
43	48	35	31
76	71	62	69
92	89	86	70
77	65	64	43
51	51	39	43
48	49	32	29
65	53	53	53
36	35	49	59
61	69	64	63
13	28	21	12
8	16	10	5
11	40	15	11
50	45	21	30

RESULTS

In comparing the curves representing the boys in Fig. 5, it is observed that the full line goes above the broken line five times—on Questions 2, 17, 18, 19, and 20. In Fig. 6, in which the girls are compared, the full line is above on Questions 3, 4, and 17. In the "one teacher" schools the "range" is 80 per cent from 18–98 per cent, and for the graded schools it is 89 per cent from 6–96 per cent. The two curves have the same general tendency, at no time running counter to one another, indicating that the questions were satisfactory. If they had not run so nearly in the same direction it would have been thought that for one system the questions were not as fair as for the other, that the results depended on method of instruction rather than subject-matter. The curves are higher when the questions bore upon

subjects connected with our own state and country, than when they bore upon other states and foreign countries.

GEOGRAPHY

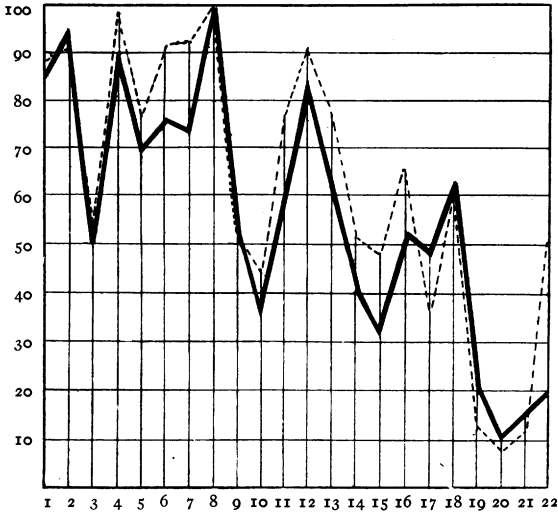


FIG. 5.—Boys

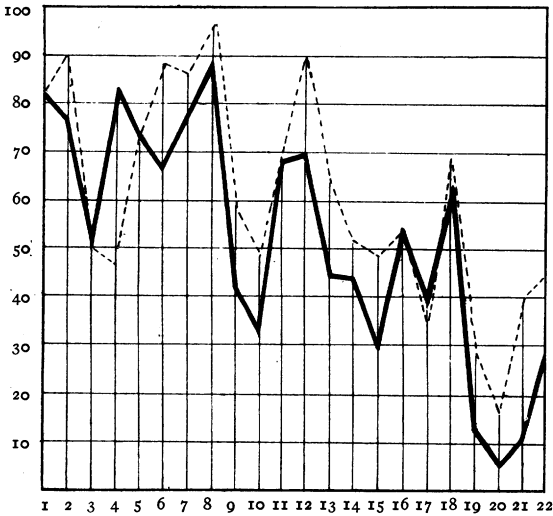


FIG. 6.—GIRLS

In comparing the results in the different groups, the average percentages were arranged in a table according to the group in which it was classified.

REASONING GROUP

Q	PERCENTAGES		
	G	O. T.	D
6	71	89	18
9	45	62	17
13	51	68	17
14	43	52	9
16	53	59	6
17	42	35	-7

COMMERCIAL

8	97	98	1
9	45	62	17
13	51	68	17
14	43	53	9
15	31	58	27
16	53	59	6
17	42	35	-7

LOCATION

1	80	84	1
2	76	76	0
4	90	97	7
5	72	72	0
10	33	47	14
11	24	31	7
18	64	71	7
22	12	40	28

PHYSICAL

3	48	42	-6
5	12	12	0
6	71	89	18
7	78	88	10
15	31	58	27
16	31	58	27
19	53	59	6
20	6	18	12
21	12	40	28

VISUAL IMAGE

1	85	85	0
4	90	97	7
5	72	72	0
10	33	47	14
18	64	71	7

In the above table, Q, O.T., G, and D, equal, respectively, the number of the question, "one teacher," graded, and difference. When the graded surpasses the "one teacher" system the difference is a negative quantity.